SHENZHOU® 神州电子

样品承认书

供应商		客户	
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物料代码：		物料代码：	
物料名称：	IC	物料名称：	
规格/型号：	BS3406ADJ-LF-Z	规格/型号：	
生产日期：		确认日期：	
送样日期：	2011 年 6 月 02 日		

供应商确认

盖章	拟制	审核	批准
	6/2	6.2	

客户确认

盖章	拟制	审核	批准

编号：

BS3406A

1MHZ, 1A synchronous step-down converter

FEATURES

- High Efficiency: Up to 95%
- 2.5V to 6V Input Voltage Range
- 1A Available Load Current
- 1MHz Constant Switching Frequency
- Output Voltage as Low as 0.6V
- 100% Duty Cycle in Dropout
- ON/OFF Control
- Cycle By Cycle Current Limit
- Auto Recovery Short Circuit Protection
- Thermal Fault Protection
- Input Under Voltage Lockout
- Integrated Soft-start
- <0.1μA Shutdown Current
- Space Saving 5-Pin TSOT23 Package

DESCRIPTION

The BS3406A is a high efficiency synchronous rectifier current mode PWM regulator.The BS3406A can operate under 2.5V to 6V input voltage. For BS3406ADJ-1.5 and BS3406ADJ-1.8, they can supply 1.5V and 1.8V output voltage respectively. The output of BS3406ADJ is adjustable over a wide range of 0.6V to 6V. The load current is up to 1A.

The BS3406A switches at a fixed 1MHZ frequency which allows designers to use small, low cost inductor and capacitor.

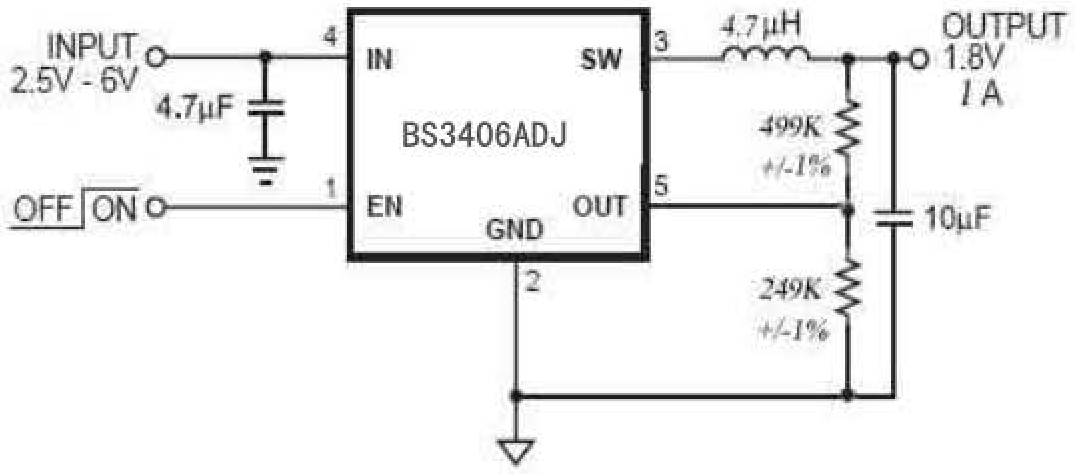
It is ideal for portable devices that driven by a single cell Lithium(Li+) battery.

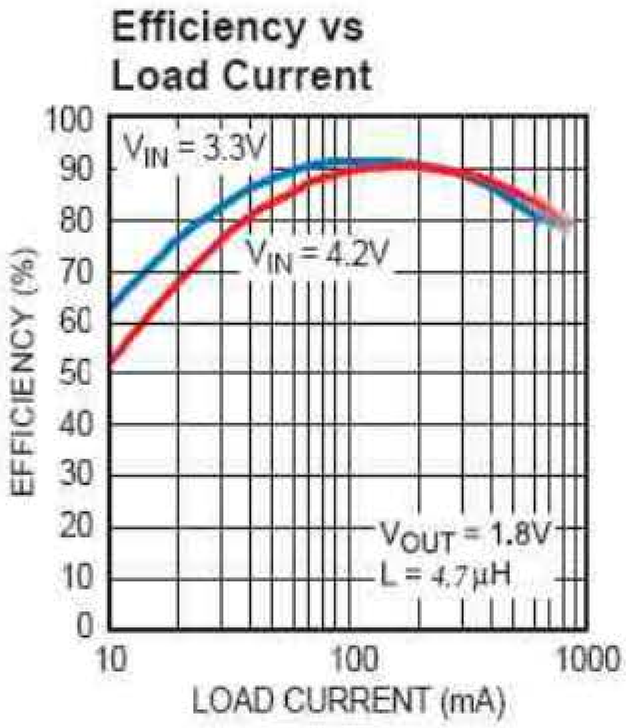
The BS3406A is available in a low profile (1mm) 5-pin, TSOT package.

APPLICATIONS

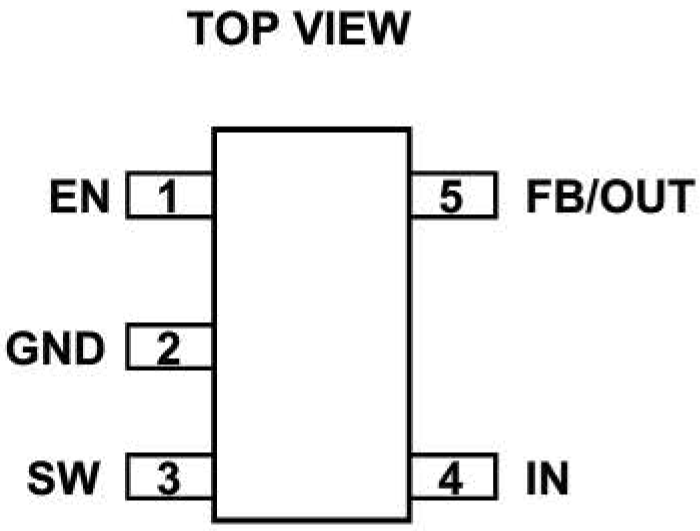
- Portable Instruments
- MP3 Players
- Digital Still and Video Cameras
- Microprocessors and DSP Core Supplies
- Cellular and Smart Phones
- PDAs

TYPICAL APPICATION





PACKAGE REFERENCE



Part Number*	Ambient Temp.	Output Voltage(V)	Package	Marking
BS3406ADJ	-40℃--80℃	0.6---6	TSOT-23	C5XX
BS3406ADJ-1.5	-40℃--80℃	1.5	TSOT-23	XXXX
BS3406ADJ-1.8	-40℃--80℃	1.8	TSOT-23	XXXX

⁎For Tape & Reel, add suffix –Z (eg. BS3406ADJ–Z) , For Lead Free, add suffix –LF (eg.BS3406ADJ–LF–Z)

PIN DESCRIPTIONS

Pin#	Name	Description
1	EN	Regulator Enable Control Input. Drive EN above 1.5V to turn on the BS3406A. Drive EN below 0.3V to turn it off (shutdown current < 0.1μA).
2	GND	Ground.
3	SW	Power Switch Output. Inductor connection to drains of the internal PFET and NFET switches.
4	IN	Supply Input. Bypass to GND with a 2.2μF or greater ceramic capacitor.
5	FB	Feedback Input (BS3406ADJ). Connect FB to the center point of the external resistor divider. The feedback threshold voltage is 0.6V.
5	OUT	Output Voltage Sense Input (BS3406ADJ-1.5 and BS3406ADJ-1.8). An internal resistor divider is connected to this pin to set the proper output voltage.

ABSOLUTE MAXIMUM RATINGS(1)

Parameter	Min.	Max.	Unit
VIN to GND	-0.3	+6.5	V
Vsw to GND	-0.3	Vin+0.3	V
VFB, VEN to GND	-0.3	+6.5	V
SW Peak Current		2.1	A
Junction Temperature		+150	℃
Lead Temperature (2)		+260	℃
Storage Temperature	-65	150	℃

Recommended Operating Conditions（3）

Parameter	Min.	Max.	Unit
Supply Voltage VIN	2.5	6	V
Output Voltage VOUT	0.6	6	V
Operating Temperature	-40	85	℃

Notes:

1) Exceeding these ratings may damage the device.

2) For recommended IR reflow temperature information, refer to BOE document BS3406A_IRRTP.

3) The device is not guaranteed to function outside of its operating conditions.

ELECTRICAL CHARACTERISTICS（5）

V_{IN} = V_{EN} = 3.6V, T_A = +25° C, unless otherwise noted.

Parameter	Conditions	Min.	Type	Max.	Unit
Supply Current	VEN = VIN, VFB = 0.65V		400	600	µA
Shutdown Current	VEN = 0V, VIN = 6V		0.01	1	µA
IN Under Voltage Lockout Threshold	Rising Edge	2.10	2.27	2.45	V
IN Under Voltage Lockout Hysteresis			55		mV
Regulated FB Voltage	TA = +25°C,	0.588	0.600	0.612	V
	–40°C ≤ TA ≤ +85°C	0.582	0.600	0.618	

ELECTRICAL CHARACTERISTICS (continued) (4)

V_{IN} = V_{EN} = 3.6V, T_A = +25° C, unless otherwise noted.

Parameter	Condition	Min.	Type	Max.	Unit
Regulated Output Voltage	BS3406ADJ-1.5 IOUT = 50mA –40°C ≤ TA ≤ +85°C	1.455	1.500	1.545	V
	BS3406ADJ-1.8 IOUT = 50mA –40°C ≤ TA ≤ +85°C	1.746	1.800	1.854	
PFET On Resistance	ISW = 100mA		0.42		Ω
NFET On Resistance	ISW = –100mA		0.26		Ω
SW Leakage Current	VEN = 0V, VIN = 6V VSW = 0V or 6V	–1		+1	μA
Thermal Resistor(5)	Junction To Case		110		℃/W
	Junction To Ambient		220		
PFET Current Limit	Duty Cycle = 100%, Current Pulse Width < 1ms	1.2	1.6	2.1	A
Oscillator Frequency		0.85	1.05	1.25	MHz
Thermal Shutdown Trip Threshold			145		℃
EN Trip Threshold	–40°C ≤ TA ≤ +85°C	0.3	0.96	1.5	V
EN Input Current	VEN = 0V to 6V	–1		+1	μA

Notes:

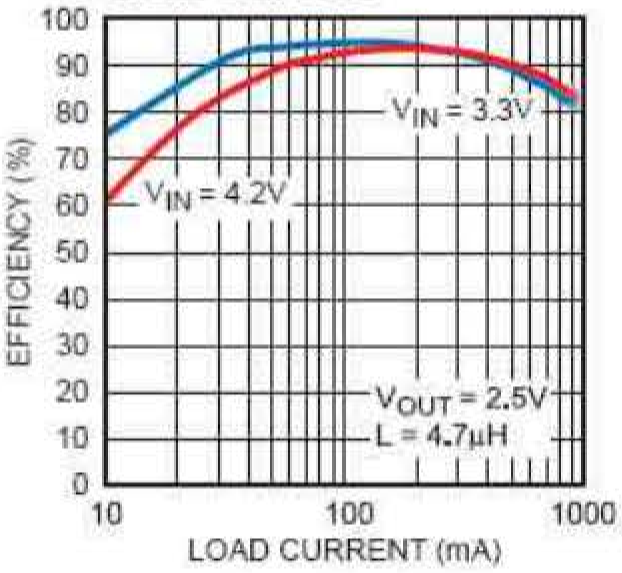
4) 100% production test at +25°C. Typical and temperature specifications are guaranteed by design and characterization.

5) Measured on approximately 1" square of 1 oz copper.

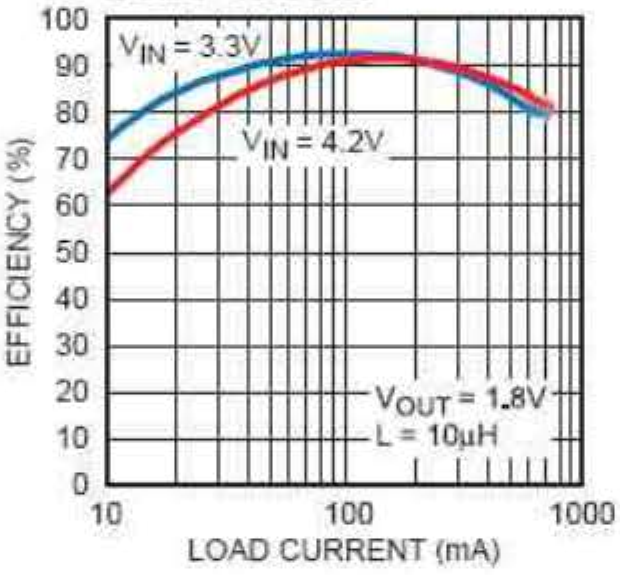
TYPICAL PERFORMANCE CHARACTERISTICS

V_{IN} = 3.3V, V_{OUT} = 1.8V, L1 = 10μH, C1 = 4.7μF, C3 = 10μF, T_A = +25°C, unless otherwise noted.

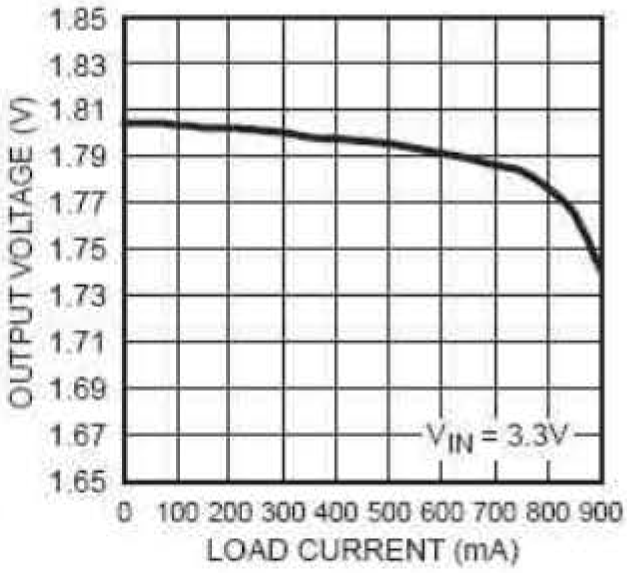
Efficiency vs Load Current



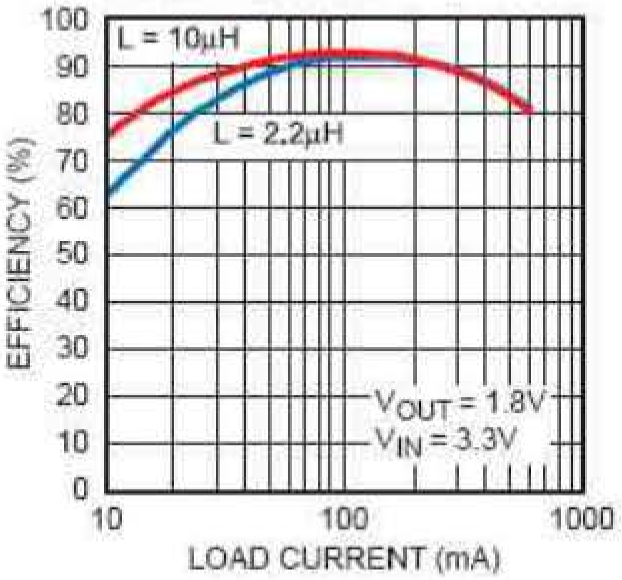
Efficiency vs Load Current



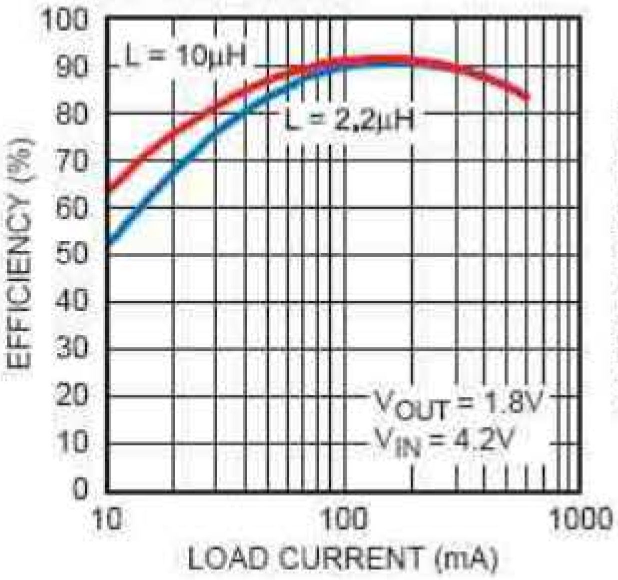
Output Voltage vs Load Current



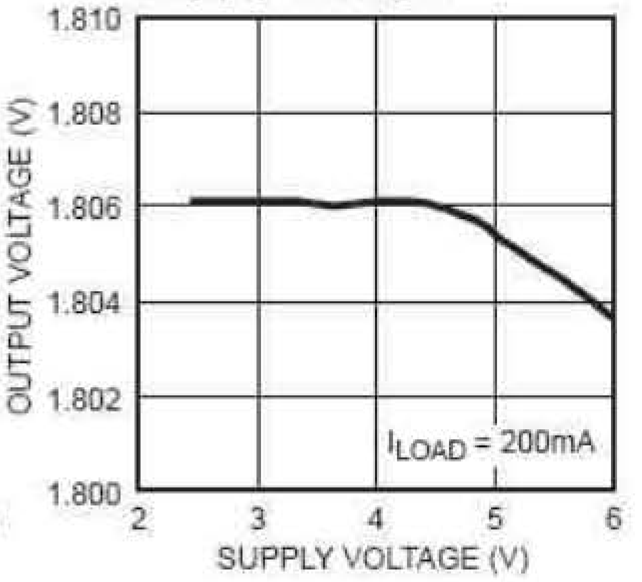
Efficiency vs Load Current



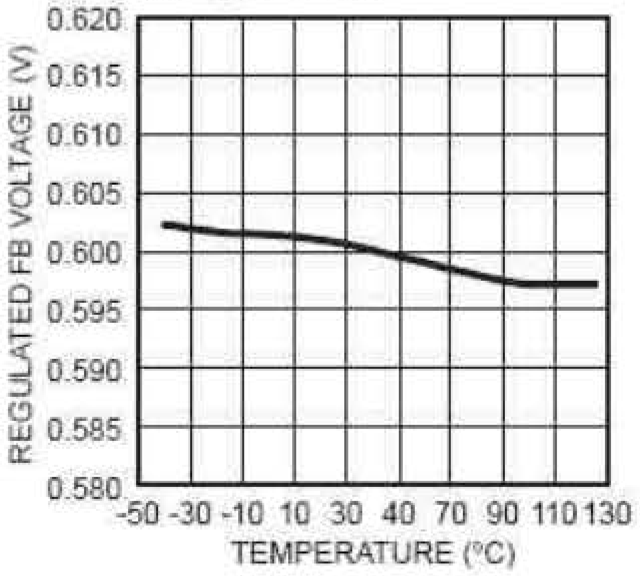
Efficiency vs Load Current



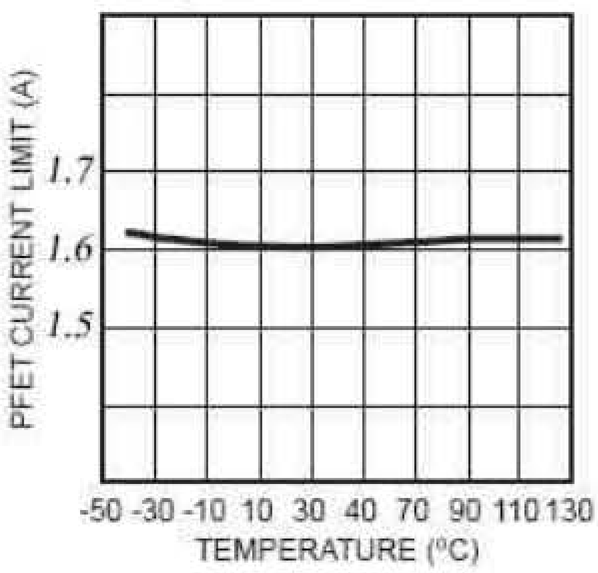
Output Voltage vs Supply Voltage



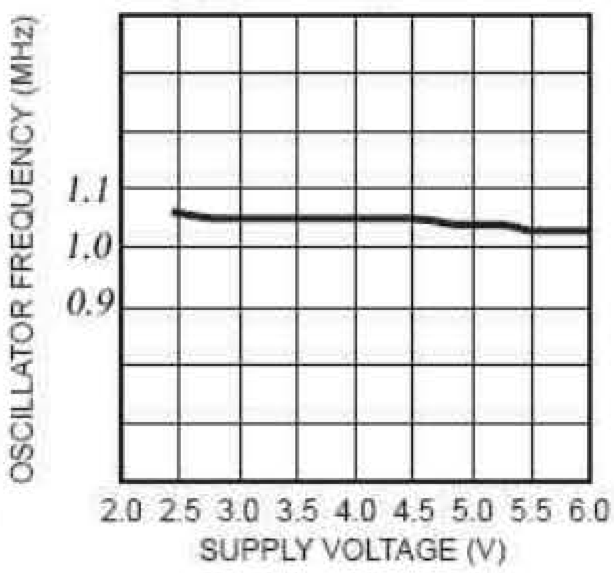
Regulated FB Voltage vs Temperature



PFET Current Limit vs Temperature



Oscillator Frequency vs Supply Voltage

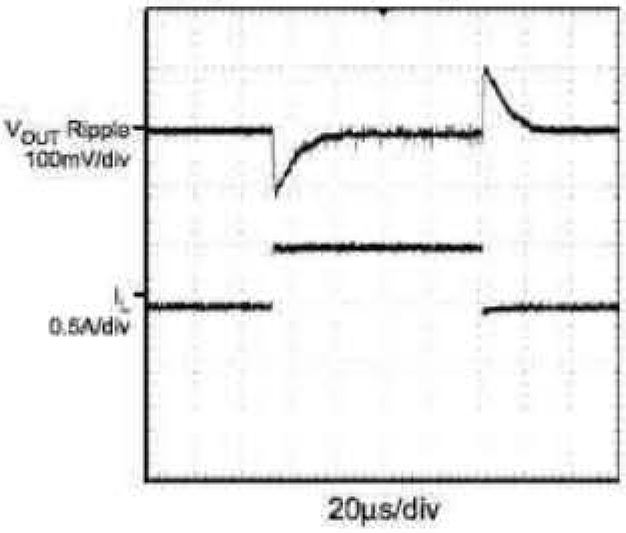


TYPICAL PERFORMANCE CHARACTERISTICS *(continued)*

V_{IN} = 3.3V, V_{OUT} = 1.8V, L1 = 10μH, C1 = 4.7μF, C3 = 10μF, T_A = +25°C, unless otherwise noted.

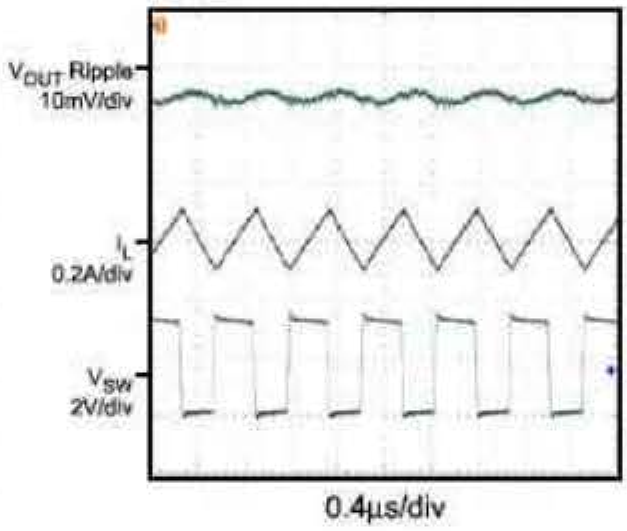
Load Transient

V_{IN} = 3.3V, V_{OUT} = 1.8V,
I_{LOAD} = 0 - 500mA Step



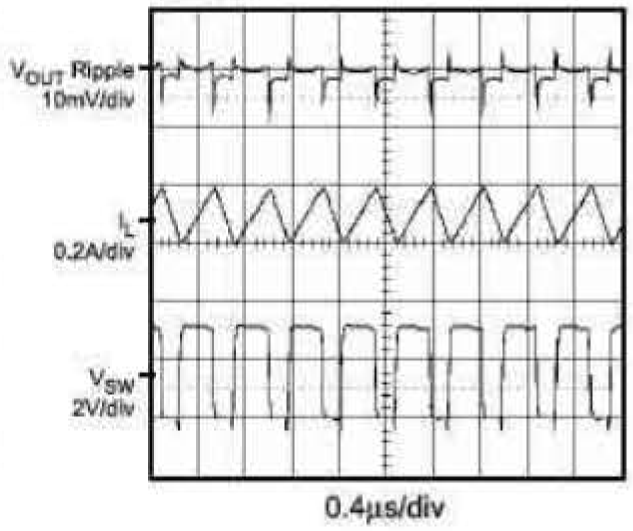
Light Load Operation

V_{IN} = 3.3V, V_{OUT} = 1.8V,
I_{LOAD} = 0A



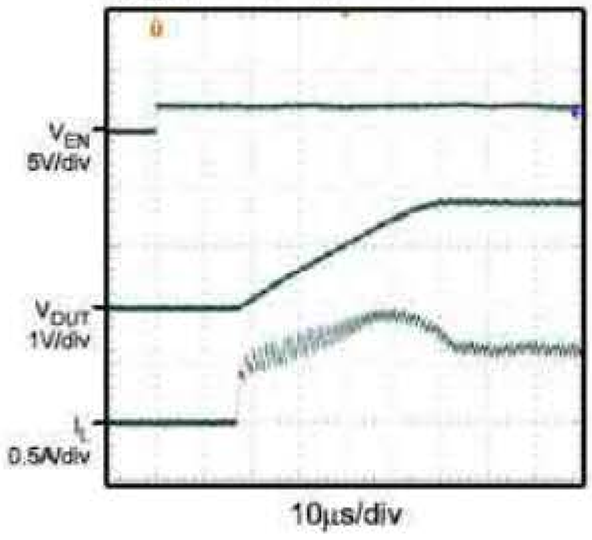
Heavy Load Operation

V_{IN} = 3.3V, V_{OUT} = 1.8V,
I_{LOAD} = 600mA



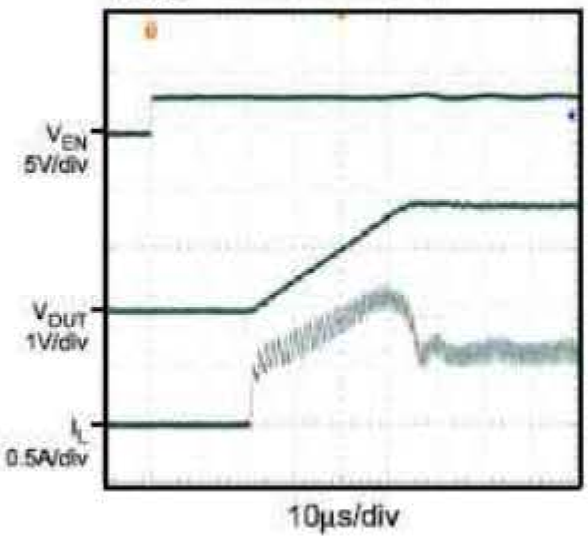
Startup from Shutdown

V_{IN} = 2.5V, V_{OUT} = 1.8V,
I_{LOAD} = 600mA Resistive



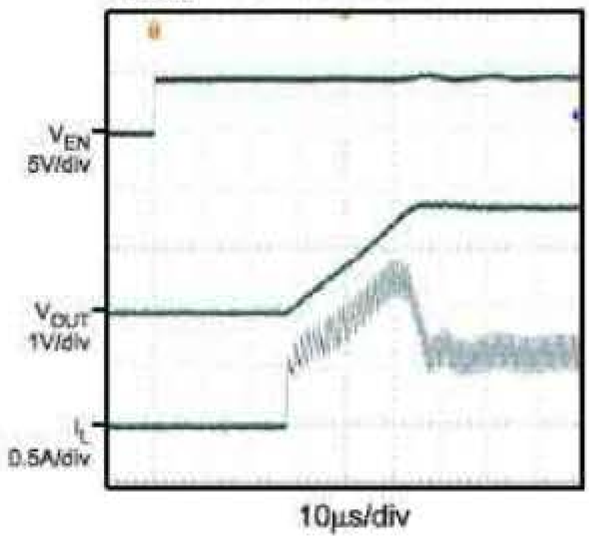
Startup from Shutdown

V_{IN} = 3.3V, V_{OUT} = 1.8V,
I_{LOAD} = 600mA Resistive



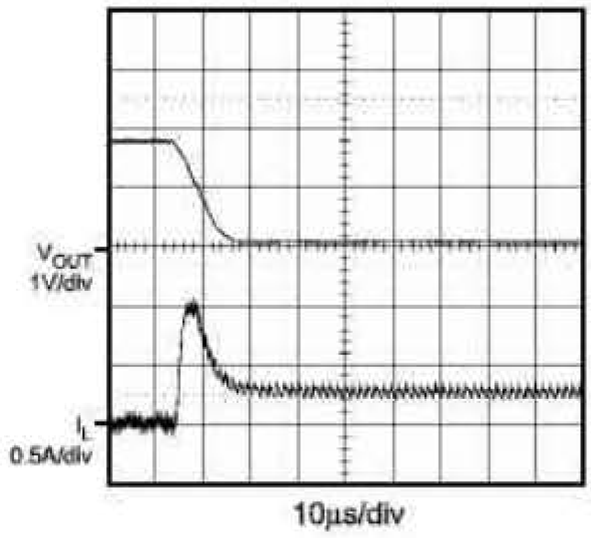
Startup from Shutdown

V_{IN} = 5V, V_{OUT} = 1.8V,
I_{LOAD} = 600mA Resistive



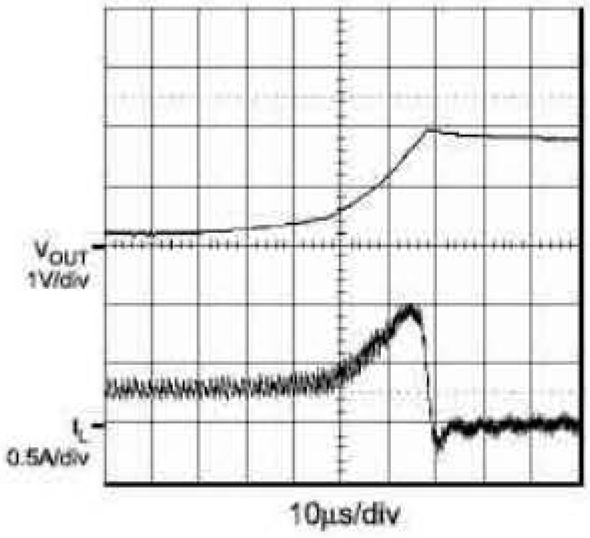
Short Circuit Protection

V_{IN} = 3.3V, V_{OUT} = 1.8V,
No Load



Short Circuit Recovery

V_{IN} = 3.3V, V_{OUT} = 1.8V,
No Load



FUNCTION BLOCK DIAGRAM

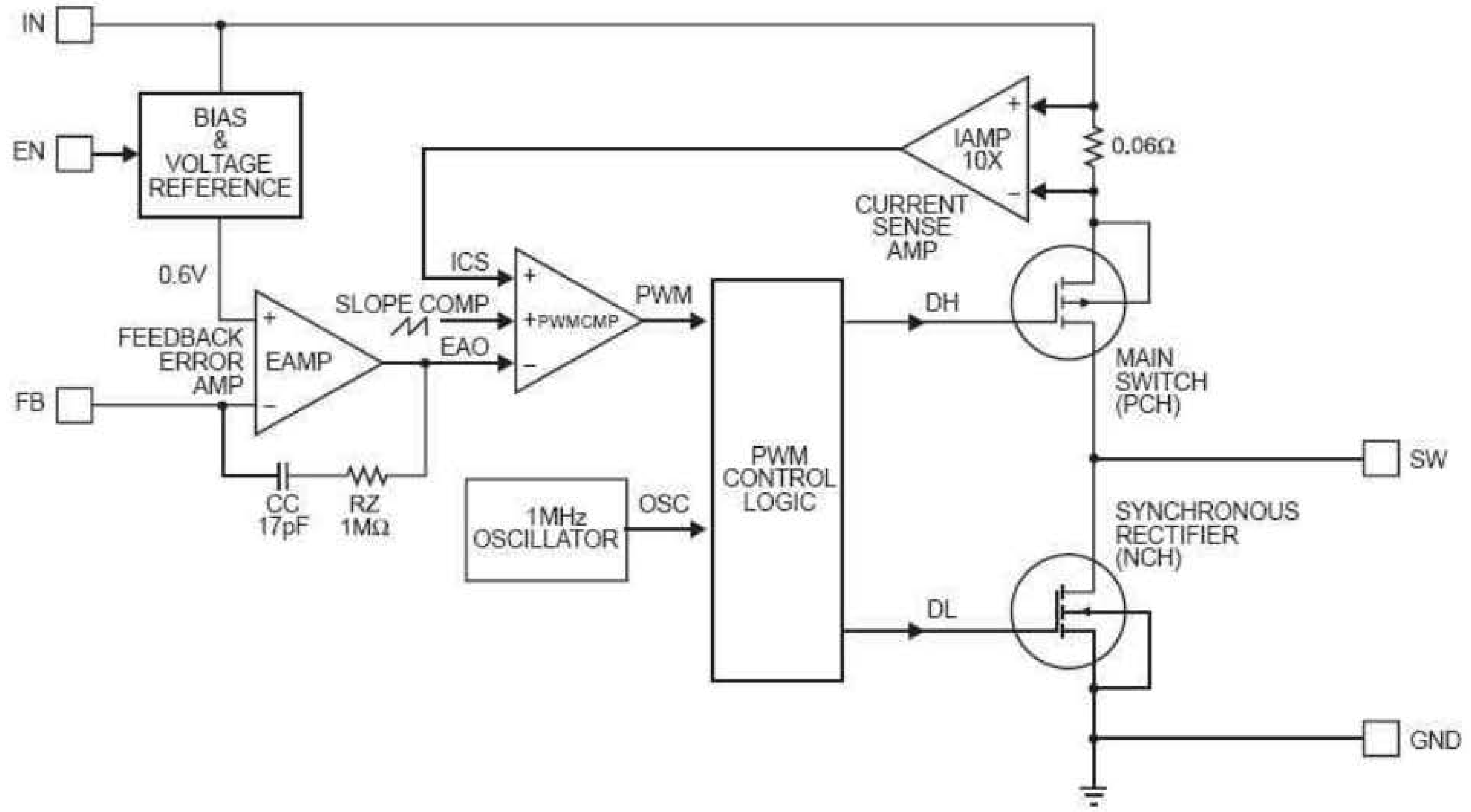


Figure1: BS3406ADJ Block Diagram

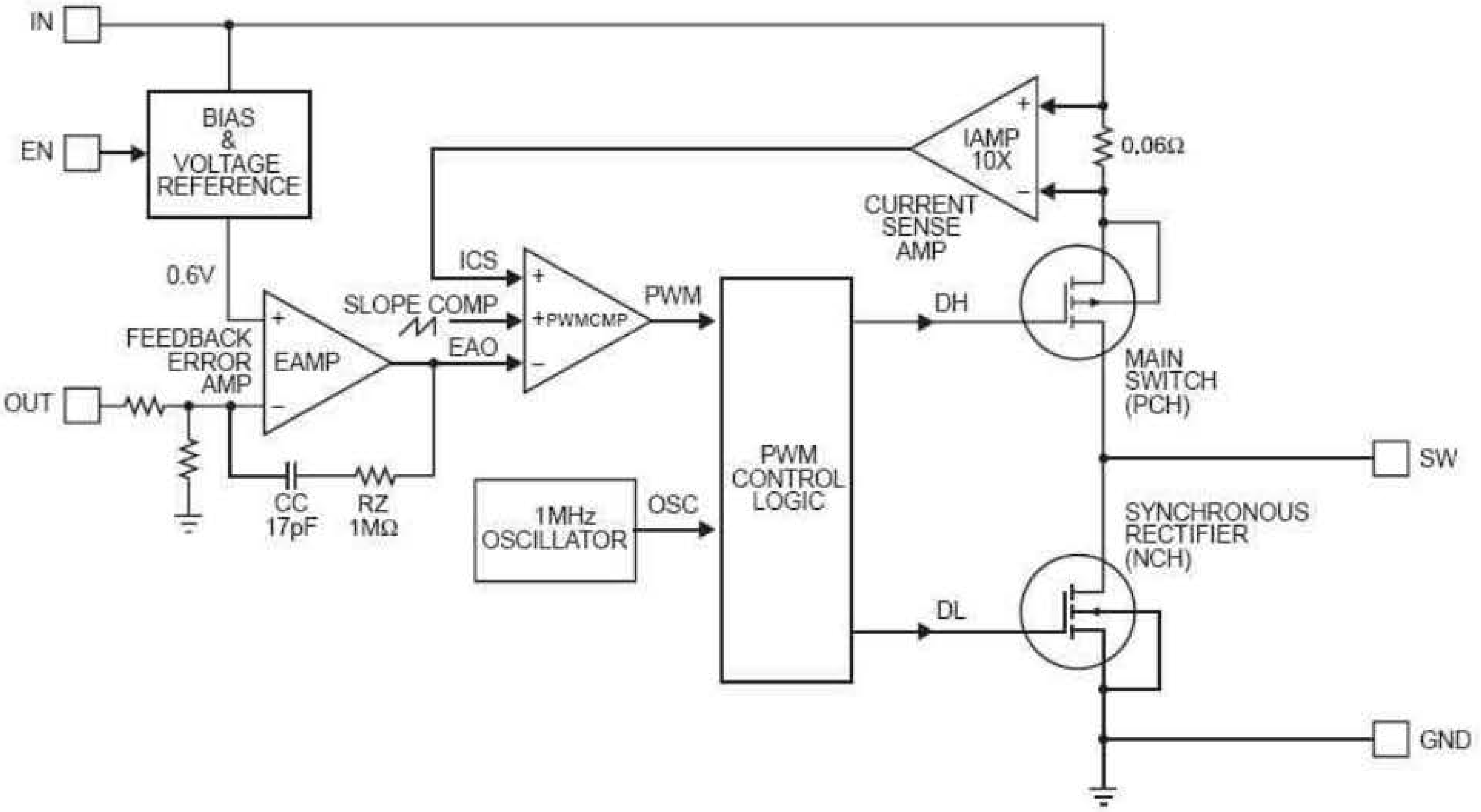


Figure2: BS3406ADJ-1.5, BS3406ADJ-1.8 Block Diagram

FUNCTION DESCRIPTION

The BS3406A is a step-down, fixed 1MHZ frequency, Synchronous rectifier converter, The output voltage Of BS3406ADJ can be regulated from 0.6V to Vin by external resistor divider. It integrates a main switch PFET and a synchronous rectifier NFET for high Efficiency without a external Scottky.

Current Mode PWM Control

The BS3406A switches at 1MHZ frequency and Regulates the output voltage. The PWM regulates The energy transferred to the output by changing The inductor current based on the feedback error Voltage. At the rising edge of each cycle, the main Switch PFET is turned on and the inductor current Ramps up until PWM comparator trips or the Current limit is reached. After the main switch is Turned off, the synchronous rectifier NFET is turned on, and The inductor current ramps down until the cycle ends. The BS3406A integrates slope compensation for more stable switching.

When Vin is approach to Vout, the duty cycle Increases. The BS3406A can achieve 100% duty cycle. The duty cycle of a step-down converter is Defined as :

$$D = T_{ON} \times f_{OSC} \times 100\% \approx \frac{V_{OUT}}{V_{IN}} \times 100\%$$

Where Ton is the main switch on time, f_{OSC} Is the oscillator frequency (1MHz), V_{OUT} is The output voltage and V_{IN} is the input voltage.

ON/OFF Control,

When EN Pin goes high , the internal function is Enable , and begin to start up. When it goes low, The BS3406A is disable.

Soft Start

BS3406A has an internal soft-start circuit that limits the The in-rush current during start-up. This Eliminate the output voltage overshoot and prevent the possible input voltage drops.

Short Circuit Protection

The BS3406A has short circuit protection. When the output is shorted to ground the oscillator frequency is reduced to prevent the inductor current from increasing beyond the PFET current limit. The PFET current limit is also reduced to lower the short circuit current. The frequency and Current limit will return to the normal values once the short circuit condition is removed and the feedback voltage reaches 0.6V.

Maximum Load current

The BS3406A can operate down to 2.5V input voltage, however the maximum load current decreases at lower input due to large IR drop on the main switch and synchronous rectifier. The slope compensation signal reduces the peak inductor current as a function of the duty cycle to prevent sub-harmonic oscillations at duty cycles greater than 50%. Conversely the current limit Increases as the duty cycle decreases.

Thermal Shutdown

When the junction temperature of the BS3406A reaches 145℃, the IC will shutdown for protection.

UVLO

The BS3406A is disable until the input voltage reaches 2.25V.

APPLICATION INFORMATION

Input Capacitor Selection

For best performance, a low-ESR capacitor is Highly recommended. When the impedance of Capacitor is less than The input capacitor impedance , it prevents high switching noise passing to the input and reduces the surge current drawn from the input. some capacitors with X5R ,X7R dielectrics has very low ESR and small temperature coefficients . For most Applications , a 4.7uF capacitor is sufficient.

Output Capacitor Selection

The output capacitor determines the output voltage Ripple and transient response . Ceramic capacitor With X5R, X7R dielectrics are recommended because Of low-ESR. The output ripple △Vou is approximately.

$$\Delta V_{OUT} \le \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{V_{IN} \times f_{OSC} \times L} \times \left(ESR + \frac{1}{8 \times f_{OSC} \times C3} \right)$$

Output Voltage setting(BS3406ADJ)

The internal reference voltage is 0.6V. The output is Set by a resistor divider. The feedback resistor R1 Also sets the feedback loop bandwidth with the Internal Compensation capacitor . (See figure1.) Choose R1 around 499kΩ for optimal transient Response. R2 is given by :

$$R2 = \frac{R1}{\frac{V_{OUT}}{0.6V} - 1}$$

Inductor Selection

The inductor parameters directly related to the device Performance are saturation current and DC resistance. A 1uH to 10uH inductor with DC current at least 25% Higher than the max. load current is recommended for Most applications. The lower the DC resistance, the higher The efficiency. Recommended inductor and manufactures are list in Table 1:

For most designs , the inductance value can be Derived from the following equation:

$$L = \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{V_{IN} \times \Delta I_L \times f_{OSC}}$$

Where ΔI_L is the inductor ripple current. Choose Inductor ripple current approximately 30% of the Maximum load current, 1A.

The maximum inductor peak current is:

$$I_{L(MAX)} = I_{LOAD} + \frac{\Delta I_L}{2}$$

In order to improve efficiency under light load current Under 100mA, high inductance value is recommended. See Table 2 for reference.

PCB layout

The high frequency and high peak current paths demands careful PCB layout. The resistor that sets the output t voltage should be routed away From the inductor to avoid RF coupling, and next To FB pin. For best performance, use wide, direct and short traces for high peak current paths such as IN, GND,SW.

Manufacture	Inductance	Part Number
Toko	2.2uH	D312C
Coilcraft	2.2uH	LP1704-222M
Sumida	2.2uH	CDRH3D16
Taiyo Yuden	2.2uH	LBC2518

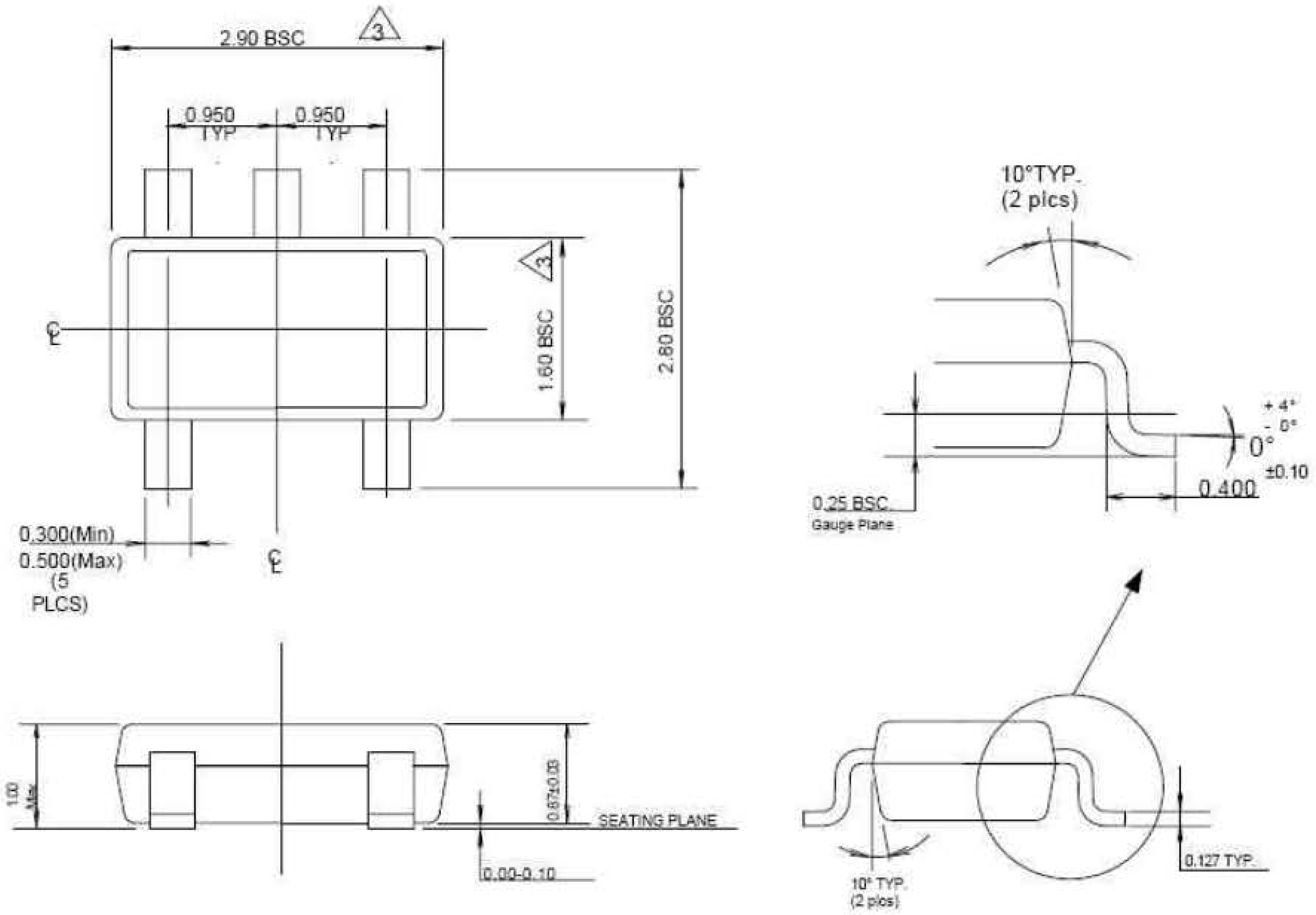
Table 1: Suggested Surface Mount Inductor

Manufacture	Inductance	Part Number
Coilcraft	10uH	DO1605T-103MX
Murata	10uH	LQH4C100K04
Sumida	10uH	CR32-100

Table 2 : Inductor for Improved Efficiency Under 100mA Load

PACKAGE INFORMATION

TSOT23-5



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